Building an Enhanced Drought Early Warning System (DEWS): Tools and Services for Decision Support

Mark Svoboda
University of Nebraska - Lincoln, msvoboda2@unl.edu

Follow this and additional works at: http://docs.lib.purdue.edu/ddad2011
Part of the Atmospheric Sciences Commons, and the Climate Commons

http://docs.lib.purdue.edu/ddad2011/11

This document has been made available through Purdue e-Pubs, a service of the Purdue University Libraries. Please contact epubs@purdue.edu for additional information.
Building an Enhanced Drought Early Warning System (DEWS): Tools and Services for Decision Support

Mark Svoboda, Climatologist
Monitoring Program Area Leader, National Drought Mitigation Center
University of Nebraska-Lincoln, USA

Symposium on Data-driven Approaches to Droughts 2011, West Lafayette, IN June 21-22, 2011
The Cycle of Disaster Management

risk management

- Preparedness
- Prediction and Early Warning
- Mitigation

Protection

Recovery

Reconstruction

Response

Impact Assessment

Disaster

crisis management
Managing Risk on the Ranch

Why Plan

"I said, if you bet on dry weather in this country, you'll be right more than half the time."

--Nebraska rancher, 2006

Drought is an everyday exercise for livestock and graziers to plan for things they can control and those that change daily. All regions experience weather events such as thunderstorms, blizzards and drought. These extremes and the unknowns that seem to be around every corner, and the disastrous effects they can cause, demonstrate why long-term planning is essential to effectively manage agricultural risk.

Drought is one hazard that affects every portion of the United States sooner or later, and producers are increasingly implementing new ways to better prepare and respond to it. The information, strategies and resources on this site are designed to provide producers with information on how to incorporate management strategies to reduce the threat drought poses to livestock and forage operations.

Our Philosophy and Purpose

- Drought is a normal part of climate...it will happen again.
- There are things you can do before, during, and after drought to reduce your risk.
- You should have both a long-term management plan and a drought response plan.
- The goal of this website is to help you become more resilient to hazards such as drought.

How to Use This Site
NDMC International Activities

Activities 2005–2010
Czech Republic • Italy • Switzerland • Spain • Slovenia • European Union • Southern Europe/Northern Africa • Morocco • Tunisia • Mali • Ethiopia • Mozambique • Namibia • Egypt • Saudi Arabia • Syria • Iraq • Jordan • India • Japan • China • South Korea • Vietnam and Cambodia • Australia • Brazil • Chile • Mexico • Canada

Activities planned in 2011
Turkey • Czech Republic • Slovakia • Austria • Australia • Canada • Mexico • India • Korea • China • Ethiopia • Nigeria • Zambia •
Drought Plan Components

- **Monitoring and early warning**
  - assess, communicate, and **trigger** action
  - **Foundation** of a drought mitigation plan

- **Vulnerability assessment**
  - Who and what is at **risk** and why?

- **Mitigation and response actions**
  - Actions/programs that **reduce risk and impacts**
    and enhance recovery

*Most processes and plans in the past have primarily focused on monitoring and response...*
“You can’t manage what you don’t measure.....and you can’t measure what you don’t monitor....”

(An old business adage applied to DEWS!)
What are Drought Monitoring and Early Warning Systems?

A drought monitoring system will *track, assess and report* climate and water supply trends and current conditions (e.g., rainfall, reservoirs, impacts, etc.) (modified from WMO – No. 1006e)

An early warning system facilitates “the *provision of timely and effective information*, through identifying institutions, that allow individuals exposed to a hazard to take action to avoid or reduce their risk and prepare for effective response” (ISDR, 2003).
Drought Monitoring State of the Science: Where are we now?

- WMO/WCC-3, GDPN/GEOSS is a way to learn/leverage from one another
  - Canada/Mexico/United States/Africa/EDO
  - UN/WMO/others
- Many regions/countries are working together to better monitor drought
- Monitoring of impacts globally is virtually non-existent
- Early warning/monitoring just one key: THEN WHAT? Need linkages to risk/vulnerability assessment and planning for adaptation
- Many indicators/indices don’t reflect reality in various regions, or for various season(s)......or for both!
the rapid onset of National Drought Centers/Strategies

- Australia
- South Africa
- Canada
- United States
- Slovenia/Southeast Europe
- Spain
- EU/JRC
- Turkey
- Portugal
- South Korea
- China
- India
- Pakistan
- Morocco
- Syria
- Brazil (Sao Paulo state)
- Jordan
- Iran
Drought Monitoring/Reporting Systems

North American Drought Monitor
April 30, 2010
http://www.ncdc.noaa.gov/drought/index.html

U.S. Drought Monitor
May 25, 2010

Rainfall deficiencies: 10 months
1 April 2002 to 31 January 2003
Distribution based on gridded data
Product of the National Climate Center

UNIVERSITY OF NEBRASKA

National Drought Mitigation Center
The Importance of Drought Early Warning Systems (DEWS)

- Allows for *early* drought detection
- Improves response (*proactive*)
- Data and tools for *decision support*
- "Triggers" actions within a drought plan
- A critical *mitigation* action
- *Foundation* of a drought plan
Components of a Drought Early Warning System (DEWS)

- Monitoring AND Forecasting
- Access to timely data
- Synthesis/analysis of data used to “trigger” set actions within a drought plan
- Tools for decision makers
- Efficient dissemination/communication (WWW, media, extension, etc.)
- Drought risk planning
- Education and Awareness
Approaches to Drought Assessment

- Single index or indicator (parameter)
- Multiple indices or indicators
- Composite (or “hybrid”) Indicator
The U.S. Drought Monitor

Since 1999, NOAA (CPC, NCDC, WRCC), USDA, and the NDMC have produced a weekly composite drought map -- the U.S. Drought Monitor -- with input from numerous federal and non-federal agencies:

- Western Region Climate Center on board 2008
- 11 authors in all
- Incorporate relevant information and products from all entities (and levels of government) dealing with drought (RCC’s, SC’s, federal/state agencies, etc.)

(300 experts)
The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

http://drought.unl.edu/dm

Released Thursday, June 16, 2011

Author: Brian Fuchs, National Drought Mitigation Center
U.S. Drought Monitor Map

Drought Intensity Categories

- D0 Abnormally Dry (30%tile)
- D1 Drought – Moderate (20%tile)
- D2 Drought – Severe (10%tile)
- D3 Drought – Extreme (5%tile)
- D4 Drought – Exceptional (2%tile)
USDM Listserve Subscribers
(as of April 1, 2011)

Total: 298 (does not include 1 participant from Canada and 1 participant from Mexico)
Tools: Drought Impact Reporter

Drought Impact Reporter
National Drought Mitigation Center

droughtreporter.unl.edu
So just what is the cost of drought?
Why Track Drought Impacts?

- Establish an impacts **baseline** for monitoring
  - Climate change
- To know where to direct **relief**
- To reduce **vulnerability** in advance of the next drought
- “**Ground truth**” indices
- No single method exists for collecting and/or **quantifying** drought losses
- Very little in the way of **environmental** or **qualitative** collection
Some Key Recommendations:
Through a strengthening of NIDIS……

* Full funding for basic data collection

- **Socio-economic data** to better understand and quantify the impacts of drought and to inform cost-effective preparedness and response strategies
- **Ecosystem data** to better understand the impacts of drought to aquatic, riparian and groundwater dependent ecosystems and species and the loss of ecosystem services
Some DIR Factoids

- Established in 2005
- DIR DB now contains >13,500 impacts
- 1,534 impacts added in 2010

![Bar chart showing impacts in the Drought Impact Reporter from 2005 to 2010.](chart_image)
Instructions: Click on a state to see the reported drought impacts that affect that state.
Instructions: Click on a county to list the reported drought impacts that affect it.
5 reported drought impacts for Travis County, Texas:

1. Farmers and ranchers in Texas who have lost livestock grazing... (click to read more)
   Categories: Agriculture Other
   Source: Media
   Dates of Impact: 2009-01-01 to 2009-09-15

2. A ban on outdoor burning is in effect for 30... (click to read more)
   Categories: Fire Other
   Source: Media
   Dates of Impact: 2009-01-13 to 2009-09-15

3. The low water level of Lake Travis is exposing more... (click to read more)
   Categories: Social Water/Energy
   Source: Media
   Dates of Impact: 2009-09-10 to 2009-09-10
What We’ve Learned: Refine Categories

Current

Map Options
Impact Categories:

- Agriculture
- Water/Energy
- Environment
- Fire
- Social
- Other

Source: All Sources

Time Period: Last Month

Submit

Planned

[+] Media Reports

- Society & Public Health
- Agriculture
- Disaster Declarations & Aid
- Energy
- Water Supply & Quality
- Wildfire
- Plants & Wildlife
- Other Business & Industry
- Tourism & Recreation
- General Awareness
Promoting the “drought impact reporting” idea to their volunteers...

* 14,000+ volunteers covering all 50 states!!

* CoCoRaHS “Message of the Day”

* Monthly e-mail reminders

* Guide to reporting drought impacts

* Banners on the Web

Courtesy: Henry Reges, Colorado State University
Challenges

- **Systematic** impact assessments are needed
- Convince decision-makers that their mitigation/adaptation actions will reduce future drought impacts
  - **Quantify** impacts and benefits
  - **Incorporate** into drought planning/mitigation
    - Proactive vs. Reactive
  - **Continual** education and awareness
- It is also hard for *mitigation measures* to compete for funding with the many urgent and immediate emergency funding needs facing governments
Tools: A New and Enhanced National Drought Atlas

- First drought atlas study done by the ACE, IBM and NOAA (Hosking, Wallis and Guttman) (early 90’s)
- Used HCN: ~1000 station 1948 to late 1980s
- New atlas utilizes GIS, digital pre-1948 data and two more decades since the first atlas release
  - Currently open, at least 40 years of data, no more than 2 consecutive missing months in the POR
  - 139 clusters/regions developed and analyzed
  - SPI, SPEI, PDSI, sc-PDSI and Deciles through 2009
  - Weekly gridded maps for all parameters back to early 1900s
- New Drought Atlas bottom line, ~3000 (P) and ~ 2300 (P+T) stations w/ ~ double the period of record when compared to the original atlas (allows for more robust statistical calculations)
Select an Atlas Station

Use one of the options below to select a station. After you’ve made your selection, click View Climate Atlas to go to the map. Or go directly to the map (you will need to select a station to view many of the data products).

By Location

Enter a latitude and longitude (in decimal degrees) or click on the map to select a point.
Latitude
Longitude
Search Radius 25 miles
Search

By Station Name

Enter the station name or COOP ID
Search

By State

Maryland
Search

Select A Station

Select a station from the list below or from the map. After making your selection, click View Climate Atlas to view Atlas data. (You can change the selected station at any time from the Climate Map page.)

180015: ABERDEEN PHILLIPS FLD
180465: BALTIMORE WASH INTL AP
180700: BELTSVILLE
181750: CHESTERTOWN
182225: DALEGARLIA RSVR
183675: GLENN DALE BELL STN
185111: LAUREL 2 W
187272: POTOMAC FLTR PLT
187320: PRINCESS ANNE
187806: ROYAL OAK 2 SSW
188000: SALISBURY
188005: SALISBURY WICOMICO RONL AP
188065: SAVAGE RIVER DAM
188280: SNOW HILL 4 N
189070: UPPER MARLBORO 2 NNW
189140: VIENNA
181750: CHESTERTOWN
Latitude  39.217
Longitude -76.052
Elevation (ft)  40
State MD
County Kent
Climate Division  5
Time Period  1/1/1937 - 12/31/2009
Years on Record  73
Percent Complete  99

The Atlas period of record can and will vary from the ACIS period of record. Stations may have had data periods that did not meet the criteria used in the Atlas. Those data periods are not included here.

More information

Atlas Region

Related Stations:
072730: DOVER
079595: WILMINGTON NEW CASTLE CO AP
079605: WILMINGTON PORTER RSV
180015: ABERDEEN PHILLIPS FLD
180465: BALTIMORE WASH INTL AP
181750: CHESTERTOWN
187330: PRINCESS ANNE
187606: ROYAL OAK 2 SSW
188000: SALISBURY
188005: SALISBURY WICOMICO RGNL AP
188380: SNOW HILL 4 N
189140: VIENNA
Results for CHESTERTOWN (181750) between 1/1/1940 and 12/31/1949, aggregated by week.

Precipitation Totals (inches)

To zoom in on the chart, click and drag across the chart area. To return to the complete chart, double-click in the chart area.

Note: these precipitation totals may include days with no data values. Please see the tabular datasets for more information.
Results for CHESTERTOWN (181750) between 1/1/1940 and 12/31/1949, aggregated by week.

### Precipitation

<table>
<thead>
<tr>
<th>Rank</th>
<th>Date</th>
<th>Total (in.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1/1/1940</td>
<td>0.00</td>
</tr>
<tr>
<td>2</td>
<td>4/22/1940</td>
<td>0.00</td>
</tr>
<tr>
<td>3</td>
<td>6/10/1940</td>
<td>0.00</td>
</tr>
<tr>
<td>4</td>
<td>6/17/1940</td>
<td>0.00</td>
</tr>
<tr>
<td>5</td>
<td>9/2/1940</td>
<td>0.00</td>
</tr>
<tr>
<td>6</td>
<td>9/16/1940</td>
<td>0.00</td>
</tr>
<tr>
<td>7</td>
<td>11/4/1940</td>
<td>0.00</td>
</tr>
<tr>
<td>8</td>
<td>1/8/1941</td>
<td>0.00</td>
</tr>
<tr>
<td>9</td>
<td>1/29/1941</td>
<td>0.00</td>
</tr>
<tr>
<td>10</td>
<td>2/19/1941</td>
<td>0.00</td>
</tr>
</tbody>
</table>

### Wettest

<table>
<thead>
<tr>
<th>Rank</th>
<th>Date</th>
<th>Total (in.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>7/16/1945</td>
<td>6.07</td>
</tr>
<tr>
<td>2</td>
<td>7/29/1948</td>
<td>4.62</td>
</tr>
<tr>
<td>3</td>
<td>4/8/1940</td>
<td>4.43</td>
</tr>
<tr>
<td>4</td>
<td>11/25/1948</td>
<td>3.88</td>
</tr>
<tr>
<td>5</td>
<td>10/15/1942</td>
<td>3.65</td>
</tr>
<tr>
<td>6</td>
<td>5/21/1949</td>
<td>3.51</td>
</tr>
<tr>
<td>7</td>
<td>10/22/1943</td>
<td>3.39</td>
</tr>
<tr>
<td>8</td>
<td>4/22/1944</td>
<td>3.35</td>
</tr>
<tr>
<td>9</td>
<td>11/25/1944</td>
<td>3.34</td>
</tr>
<tr>
<td>10</td>
<td>7/30/1949</td>
<td>3.28</td>
</tr>
</tbody>
</table>

### Temperature - Warmest

#### Tmax

<table>
<thead>
<tr>
<th>Rank</th>
<th>Date</th>
<th>Average (°F)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>7/22/1940</td>
<td>96.00</td>
</tr>
<tr>
<td>2</td>
<td>7/23/1949</td>
<td>95.86</td>
</tr>
<tr>
<td>3</td>
<td>8/6/1949</td>
<td>93.67</td>
</tr>
<tr>
<td>4</td>
<td>8/6/1943</td>
<td>92.29</td>
</tr>
<tr>
<td>5</td>
<td>7/30/1943</td>
<td>92.00</td>
</tr>
</tbody>
</table>

#### Tmin

<table>
<thead>
<tr>
<th>Rank</th>
<th>Date</th>
<th>Average (°F)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>7/16/1949</td>
<td>74.14</td>
</tr>
<tr>
<td>2</td>
<td>8/12/1944</td>
<td>73.29</td>
</tr>
<tr>
<td>3</td>
<td>7/22/1940</td>
<td>72.00</td>
</tr>
<tr>
<td>4</td>
<td>7/23/1949</td>
<td>71.86</td>
</tr>
<tr>
<td>5</td>
<td>8/13/1947</td>
<td>71.29</td>
</tr>
</tbody>
</table>
The Standardized Precipitation Index (SPI) is an index based on the probability of precipitation for any time scale. The understanding is that a deficit of precipitation has different impacts on groundwater, reservoir storage, soil moisture, snowpack, and streamflow. The SPI was designed to quantify the precipitation deficit for multiple time scales. These time scales reflect the impact of drought on the availability of the different water resources. Soil moisture conditions respond to precipitation anomalies on a relatively short scale. Groundwater, streamflow, and reservoir storage reflect the longer-term precipitation anomalies.

The SPI calculation for any location is based on the long-term precipitation record for a desired period. This long-term record is fitted to a probability distribution, which is then transformed into a normal distribution so that the mean SPI for the location and desired period is zero (Edwards and McKee, 1997). Positive SPI values indicate greater than median precipitation, and negative values indicate less than median precipitation. Because the SPI is normalized, wetter and drier climates can be represented in the same way, and wet periods can also be monitored using the SPI.

A drought event occurs any time the SPI is continuously negative and reaches an intensity of -1.0 or less. The event ends when the SPI becomes positive. Each drought event, therefore, has a duration defined by its beginning and end, and intensity for each month that the event continues. The positive sum of the SPI for all the months within a drought event can be termed the drought's "magnitude".
Results for CHESTERTOWN (181750) for the 3, 18 Month timestep(s) between 1/1/1940 and 12/31/1949

To zoom in on the chart, click and drag across the chart area. To return to the complete chart, double-click in the chart area.
Results for CHESTERTOWN (181750) for the 3, 9, 18 Month timestep(s) between 1/1/1940 and 12/31/1949

### October

#### 3 Month

<table>
<thead>
<tr>
<th>Rank</th>
<th>Year</th>
<th>SPI</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1941</td>
<td>-1.58</td>
</tr>
<tr>
<td>2</td>
<td>1943</td>
<td>-1.27</td>
</tr>
<tr>
<td>3</td>
<td>1947</td>
<td>-0.66</td>
</tr>
<tr>
<td>4</td>
<td>1940</td>
<td>-0.56</td>
</tr>
<tr>
<td>5</td>
<td>1944</td>
<td>-0.33</td>
</tr>
<tr>
<td>6</td>
<td>1948</td>
<td>-0.27</td>
</tr>
<tr>
<td>7</td>
<td>1949</td>
<td>0.01</td>
</tr>
<tr>
<td>8</td>
<td>1946</td>
<td>0.04</td>
</tr>
<tr>
<td>9</td>
<td>1945</td>
<td>0.24</td>
</tr>
<tr>
<td>10</td>
<td>1942</td>
<td>0.65</td>
</tr>
</tbody>
</table>

#### 9 Month

<table>
<thead>
<tr>
<th>Rank</th>
<th>Year</th>
<th>SPI</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1941</td>
<td>-1.44</td>
</tr>
<tr>
<td>2</td>
<td>1943</td>
<td>-1.22</td>
</tr>
<tr>
<td>3</td>
<td>1946</td>
<td>-0.65</td>
</tr>
<tr>
<td>4</td>
<td>1947</td>
<td>-0.62</td>
</tr>
<tr>
<td>5</td>
<td>1949</td>
<td>-0.13</td>
</tr>
<tr>
<td>6</td>
<td>1944</td>
<td>-0.13</td>
</tr>
<tr>
<td>7</td>
<td>1940</td>
<td>0.08</td>
</tr>
<tr>
<td>8</td>
<td>1942</td>
<td>0.08</td>
</tr>
<tr>
<td>9</td>
<td>1948</td>
<td>0.37</td>
</tr>
<tr>
<td>10</td>
<td>1945</td>
<td>0.90</td>
</tr>
</tbody>
</table>

#### 18 Month

<table>
<thead>
<tr>
<th>Rank</th>
<th>Year</th>
<th>SPI</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1941</td>
<td>-1.30</td>
</tr>
<tr>
<td>2</td>
<td>1942</td>
<td>-0.98</td>
</tr>
<tr>
<td>3</td>
<td>1944</td>
<td>-0.77</td>
</tr>
<tr>
<td>4</td>
<td>1947</td>
<td>-0.72</td>
</tr>
<tr>
<td>5</td>
<td>1940</td>
<td>-0.72</td>
</tr>
<tr>
<td>6</td>
<td>1940</td>
<td>-0.24</td>
</tr>
<tr>
<td>7</td>
<td>1945</td>
<td>0.45</td>
</tr>
<tr>
<td>8</td>
<td>1946</td>
<td>0.48</td>
</tr>
<tr>
<td>9</td>
<td>1948</td>
<td>0.54</td>
</tr>
<tr>
<td>10</td>
<td>1949</td>
<td>0.86</td>
</tr>
</tbody>
</table>

### November

#### 3 Month

<table>
<thead>
<tr>
<th>Rank</th>
<th>Year</th>
<th>SPI</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1941</td>
<td>-2.15</td>
</tr>
<tr>
<td>2</td>
<td>1948</td>
<td>-1.03</td>
</tr>
<tr>
<td>3</td>
<td>1945</td>
<td>-0.60</td>
</tr>
<tr>
<td>4</td>
<td>1944</td>
<td>-0.56</td>
</tr>
<tr>
<td>5</td>
<td>1940</td>
<td>-0.43</td>
</tr>
<tr>
<td>6</td>
<td>1949</td>
<td>-0.15</td>
</tr>
</tbody>
</table>

#### 9 Month

<table>
<thead>
<tr>
<th>Rank</th>
<th>Year</th>
<th>SPI</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1941</td>
<td>-1.84</td>
</tr>
<tr>
<td>2</td>
<td>1943</td>
<td>-1.00</td>
</tr>
<tr>
<td>3</td>
<td>1946</td>
<td>-0.72</td>
</tr>
<tr>
<td>4</td>
<td>1949</td>
<td>-0.68</td>
</tr>
<tr>
<td>5</td>
<td>1944</td>
<td>-0.09</td>
</tr>
<tr>
<td>6</td>
<td>1947</td>
<td>0.00</td>
</tr>
</tbody>
</table>

#### 18 Month

<table>
<thead>
<tr>
<th>Rank</th>
<th>Year</th>
<th>SPI</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1941</td>
<td>-1.69</td>
</tr>
<tr>
<td>2</td>
<td>1944</td>
<td>-0.95</td>
</tr>
<tr>
<td>3</td>
<td>1942</td>
<td>-0.76</td>
</tr>
<tr>
<td>4</td>
<td>1947</td>
<td>-0.58</td>
</tr>
<tr>
<td>5</td>
<td>1943</td>
<td>-0.57</td>
</tr>
<tr>
<td>6</td>
<td>1940</td>
<td>-0.11</td>
</tr>
</tbody>
</table>
Results for CHESTERTOWN (181750) for the 18 Month timestep(s) between 1/1/1940 and 12/31/1949
U.S. Drought Monitor

The United States Drought Monitor (USDM) is a consolidation of indices that has been released on a weekly basis since 1999. Tracking drought blends science and art. No single definition of drought works for all circumstances, so people rely on drought indices to detect and measure droughts. But no single index works under all circumstances, either. That's why we need the Drought Monitor, a synthesis of multiple indices and impacts that represents a consensus of federal and academic scientists. The product has been refined over time as we find ways to make it better reflect the needs of decision-makers and others who use the information.

- **Time Series**
  View the Drought Monitor through time.

- **Table**
  View the DM raw data.

- **Heatmap**
  View the DM as a heatmap.
Results for CHESTERTOWN (181750, County) between 1/1/2000 and 12/31/2009.

To zoom in on the chart, click and drag across the chart area. To return to the complete chart, double-click in the chart area.

U.S. Drought Monitor (source)
Results for CHESTERTOWN (181750) at the 6 Month timestep with a minimum drought class of -1.5 between 1/1/1937 and 12/31/2009.

Number of Droughts: 15
Longest Drought: 25 weeks
Average Duration: 11 weeks
Time in Drought: 5.77%
Show 50 entries

<table>
<thead>
<tr>
<th>Drought Start</th>
<th>Drought End</th>
<th>Duration (weeks)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5/14/1986</td>
<td>10/29/1986</td>
<td>25</td>
</tr>
<tr>
<td>11/26/1965</td>
<td>4/16/1966</td>
<td>21</td>
</tr>
<tr>
<td>9/10/2007</td>
<td>1/1/2008</td>
<td>17</td>
</tr>
<tr>
<td>4/16/1977</td>
<td>7/30/1977</td>
<td>16</td>
</tr>
<tr>
<td>12/3/1941</td>
<td>1/29/1942</td>
<td>9</td>
</tr>
<tr>
<td>7/16/1987</td>
<td>9/3/1987</td>
<td>8</td>
</tr>
<tr>
<td>10/8/1993</td>
<td>11/19/1993</td>
<td>7</td>
</tr>
<tr>
<td>12/17/1998</td>
<td>1/8/1999</td>
<td>4</td>
</tr>
<tr>
<td>5/14/1955</td>
<td>6/4/1955</td>
<td>4</td>
</tr>
<tr>
<td>4/23/1938</td>
<td>5/14/1938</td>
<td>4</td>
</tr>
</tbody>
</table>
Results for CHESTERTOWN (181750) at the 12 Month timestep with a minimum drought class of 10 between 1/1/1937 and 12/31/2009.

Number of Droughts: 29
Longest Drought: 54 weeks
Average Duration: 13 weeks
Time in Drought: 10.96%

Show 50 entries

<table>
<thead>
<tr>
<th>Drought Start</th>
<th>Drought End</th>
<th>Duration (weeks)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10/1/1965</td>
<td>10/8/1966</td>
<td>54</td>
</tr>
<tr>
<td>1/1/1977</td>
<td>11/19/1977</td>
<td>47</td>
</tr>
<tr>
<td>9/3/1941</td>
<td>5/7/1942</td>
<td>36</td>
</tr>
<tr>
<td>12/2/1980</td>
<td>7/9/1981</td>
<td>32</td>
</tr>
<tr>
<td>9/10/1986</td>
<td>12/24/1986</td>
<td>16</td>
</tr>
<tr>
<td>1/1/1937</td>
<td>4/2/1937</td>
<td>14</td>
</tr>
<tr>
<td>11/12/2007</td>
<td>1/29/2008</td>
<td>12</td>
</tr>
<tr>
<td>1/1/1988</td>
<td>2/12/1988</td>
<td>7</td>
</tr>
<tr>
<td>4/9/1965</td>
<td>5/21/1965</td>
<td>7</td>
</tr>
<tr>
<td>8/20/1995</td>
<td>9/24/1995</td>
<td>6</td>
</tr>
</tbody>
</table>
Drought Index Comparisons for 181750 (CHESTER TOWN).

- **2002: DM** - 4.00
- **2002: DECILES 6** - 5.00
- **2002: SPI 9** - -2.01

Select up to six datasets for comparison. To remove a dataset from the comparison, click the Remove Dataset button. To clear all datasets from the comparison, click the Clear All button. The datasets can be reordered at any time by dragging the rows.

All data for the comparisons is aggregated by week. Drought Monitor data represents the county-level data for the selected station.
Tools: VegDRI
Vegetation Drought Response Index (VegDRI)

**VegDRI** is a new ‘hybrid’ drought index that integrates:

- satellite-based observations of vegetation conditions
- climate-based drought index data
- biophysical characteristics of the environment

to produce 1-km spatial resolution maps that depict ‘drought-related vegetation stress’.

Provide seamless, national-level monitoring capabilities that provides local-scale information (i.e., county to sub-county level) regarding the level of drought stress on vegetation.
Satellite-based 1-km NDVI (normalized difference vegetation index) observations provide spatially detailed information regarding the general state and condition of vegetation.

Variables:
- percent annual seasonal greenness (PASG)
- start of season anomaly (SOSA)

Measure of ‘broad scale’ geographic patterns of dryness.

Variables:
- standardized precipitation index (SPI)
- Palmer drought severity index (PDSI)

Environmental characteristics that influence climate-vegetation interactions.

Variables:
- land use/land cover type
- soil characteristics
- elevation
- ecological setting

VegDRI Methodology

1. Historical Database Development

**Satellite Data**

- **Data Input Variables**
  1. Percent Annual Seasonal Greenness (PASG)
  2. Start of Season Anomaly (SOSA)

**Climate Data**

- 1) Palmer Drought Severity Index (PDSI)
- 2) Standardized Precip. Index (SPI)

**Biophysical Data**

- 1) land use/cover type
- 2) soil available water capacity (STATSGO)
- 3) ecoregion type
- 4) irrigation status
- 5) elevation

2. Model Development

Regression Tree Model (*)

3. Map Generation

1-km VegDRI Map

(*) Models developed from a 20-year historical record (1989 – 2008) of bi-weekly climate and AVHRR satellite observations at 2,200+ weather station locations.

Biophysical variables are static over time.
Operational VegDRI Production

- Weekly and bi-weekly map updates
- Several ‘value added’ products
  - change maps
  - time-series animations
  - classified area map tables
  - map narrative
- 20+ year historical record of VegDRI maps (1989 to present)
- International interest to apply VegDRI approach
  - Canada (* Pilot project in 2011)
  - Europe
  - India
  - Argentina

VegDRI website:  http://www.drought.unl.edu/vegdri/VegDRI_Main.htm
Considerations for Using Remote Sensing Products in a Drought Early Warning System

1. Geographic coverage and spatial scale of the EWS
   - national (Turkey), provincial, or local
   - parcel/field-level, province-level, or national-level

2. Time Interval of the EWS Monitoring Updates
   - weekly, bi-weekly, and/or monthly

3. Data cost
   - Many data sets available at little or no cost.
   - High resolution data applicable for field-level assessment typically are more costly, cover a small geographic area, and less frequently acquired (weeks to months).

4. Format of data to be used in the EWS for monitoring
   - digital data for quantitative analysis in geographic information system (GIS)
   - hardcopy (paper) maps for qualitative (visual) analysis
Tools: Planning

- All droughts are local, yet most planning has been top down
- Seeing a trend toward more place-based planning at the local level
- Ranch Planning, Drought Ready Communities, etc.
The Drought Ready Community Project

- 2 years (June 2008-June 2010)
- Funded by NOAA’s Climate Program Office Sectoral Applications Research Program (SARP), and NIDIS
- Plans to follow on with APA and ICLEI

http://drought.unl.edu/plan/DRC.htm
1: Invite & Commit
2: Gather Information
3: Start Monitoring
4: Plan for Education & Awareness
5: Plan Responses to Reduce Impacts
Worksheets

- Benefits of Drought Planning
- Contact List
- Perceptions of Drought
- Available Water Supplies
- Top Water Users
- Cost-Benefit Comparison
- Linking Thresholds to Actions
A list of drought indicators the community should regularly monitor including:

- One large-scale climate indicator.
- One locally generated indicator directly relevant to your community’s water supply.
- Drought impact indicators.

The names of people who will check the indicators, and the schedule for checking.

Frequency may increase along with drought conditions, i.e., from monthly to weekly to daily.
Goal of **NIDIS**: Improve the nation’s capacity to ‘proactively’ manage drought-related risks by providing decision makers with the best available information and tools to assess the impact of drought and to better prepare for and mitigate the effects of drought.
Roles of the NDMC in NIDIS

- Co-Chair of the NIDIS Executive Council
  - Wilhite, Director of UNL-SNR

- NIDIS Program Implementation Team (Hayes Co-Chair)
  - Svoboda, Bathke, and Hayes

- U.S. Drought Portal Co-Chair (Svoboda)

- Engaging Preparedness Communities Co-Chair (Bathke)

- NIDIS Portal Help Desk

- NIDIS Pilot Project Coordination Workshops

- NIDIS Regional Drought Monitor/EWS Projects (Svoboda, Wardlow, and Fuchs)
NIDIS Engaging Preparedness Communities Working Group

Establishing a sustainable network of drought stakeholders

UNL Project approval number (IRB# 20101111010 EX)
Preparedness

Drought planning

Pro-active mitigation measures

Public education

NIDIS Implementation Plan, 2007
EPC Working Group Goal:

Assist entities in planning for and reducing the risks associated with drought

- Establish collaborative networks
  - Drought coordinators
  - Scientists
  - Policy makers
- Lead development
  - Drought exercises
  - Post-drought assessments
- Highlight success
  - Case studies
  - Best practice documents

NIDIS Implementation Plan, 2007
Approach

Create & Educate
through the development of a drought plan database

Establish
communication with state & local drought contacts through a series of short surveys

Expand
communication through a sequence of webinars

Engage
stakeholders through an annual workshop

Sustain
communication through virtual communities on the drought web portal
June 2008

• NIDIS Kansas City workshop

Summer 2010

• Began database creation
• Project approval

Winter 2010

• Establish Communication

Spring 2011

• Deploy surveys
• 1st webinar

June 2011

• NIDIS Chicago workshop
Going Global: eGaddis!
**Individually**, many nations will be unable to improve their drought coping capacity.

**Collectively**, through global, regional, and national **partnerships**, we can share information and experiences to reduce the impacts of drought.
Potential Regional Networks

- Mediterranean N. Africa Network
- Southeastern and Central European Network
- West Asia Network
- Asian Network
- Sub-Saharan African Network
- Caribbean Network
- South American Network
- North American Network
Regional DEWS Networks

Global Drought Preparedness Network - UNISDR
COUNTRIES IN CRISIS REQUIRING EXTERNAL ASSISTANCE
(total: 31 countries)

Table View
Latest Headlines:
- HAITI: Urban Price Update, February 6
- NIGER: Forage deficits raise animal mortality risk
- NIGER: Govt survey suggests above-normal food insecurity
- HAITI: Impacts of the earthquake on food security
- SUDAN: Escalated conflict worsens food security
- CHAD: Elevated malnutrition & mortality in the west

Estimated food security conditions, 1st Quarter 2010 (January-March)

The FEWS NET Food Insecurity Severity Scale [Read Descriptions]

Geographic data are partly derived from the UN/FAO GADM system. [Read Disclaimer]
The growing problem of drought and its impact on long-term sustainability of Earth’s water resources has been recognized for many years. At a 2007 GEO Ministerial Summit, the event concluded with a U.S. proposal that technical representatives from participating countries build upon existing programs to work toward establishing a Global Drought Early Warning System (GDEWS) within the coming decade to provide:

- A system of systems for data & information sharing, communication, & capacity building to take on the growing worldwide threat of drought
- Regular drought warning assessments issued as frequently as possible with increased frequency during a crisis
Future Drought Monitoring Challenges
The Big Five:

- **Impact** collection/quantification
- **Soil moisture** (especially *in situ*)
- **Hydrology** (surface *and* groundwater)
- Application of **remotely sensed/modeled/forecast** products operationally
  - **Trust**
  - **Transition from research to operational**
  - **Uncertainty**
- **Ecological/Environmental** (D-x E?)
  - Unmanaged systems (*rangeland/pastureland or irrigated* vs. *non-irrigated*)
  - “If a drought occurs in the desert, does anybody see it?”
Final Thoughts on DEWS

- All droughts are **LOCAL**
  - Monitoring local/regional/national/global (bottom-up or top-down or a combination of both)
  - Planning local/regional/national

- Collaboration (plenty of room left at the table!)
  - Leverage resources
  - Leverage skills/products (DRINET)
  - Data sharing (derivative and/or joint products)
  - Dissemination

- Ownership

- Attribution for all

- Communication/Transparency
Please visit the NDMC website for more information: http://drought.unl.edu

Thanks!

Contact me at:
Mark Svoboda
402-472-8238
msvoboda2@unl.edu